

# A Progress Report on Combining MODIS and CALIPSO Aerosol Data for Direct Radiative Effect Studies

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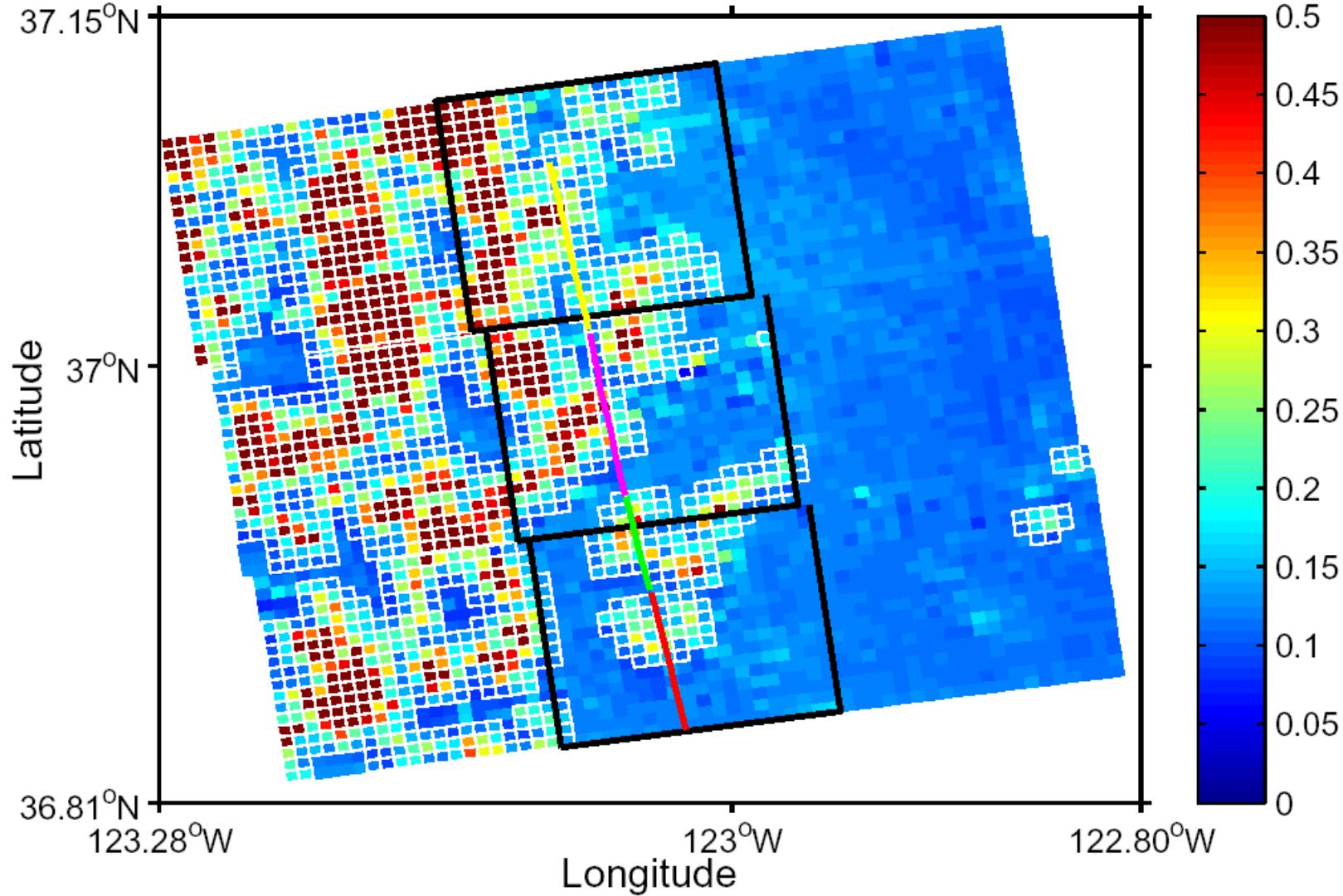
# Outline

- ↗ A discourse on cloud edge aerosol retrievals
- ↗ Goal: To devise a new, multi-instrument methodology to derive vertical structure of  $\Delta F(z)$ 
  1. CALIOP observations of aerosol backscatter/extinction profiles
  2. MODIS full column AOD (and cloud screening)
  3. OMI aerosol absorption optical depth
  4. Satellite flux measurements (CERES-like)
- ↗ First step: find commonalities between coincident and collocated MODIS-Aqua and CALIPSO observations
- ↗ Study examples of cloud screening/detection methods
- ↗ Make detailed comparisons of instantaneously collocated MODIS and CALIPSO AOD retrievals, April 2007
- ↗ Purpose: Provide input for CALIPSO aerosol extinction retrieval algorithm team & define a suitable data sets for combined analysis
- ↗ Conclusions

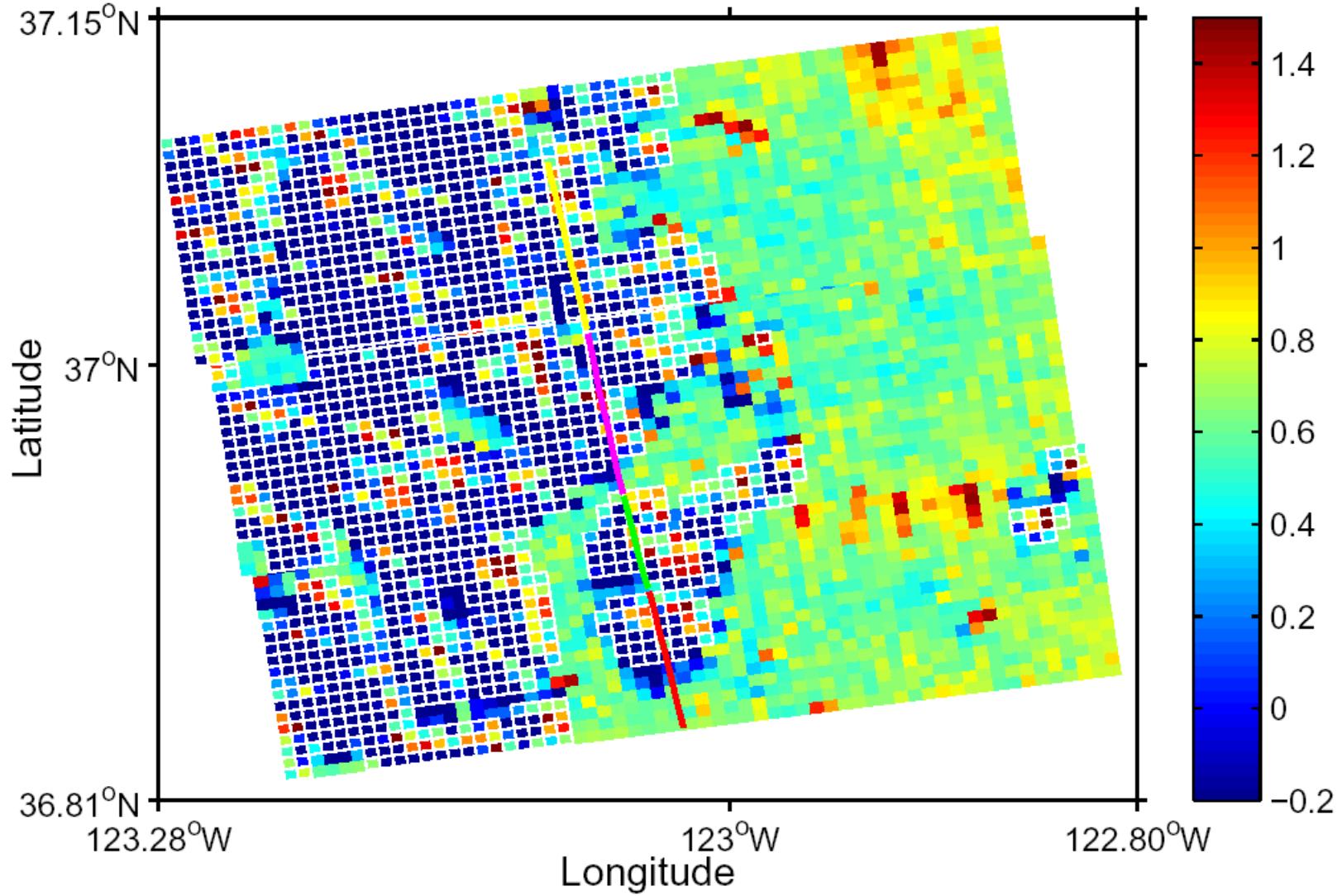


# A discourse on cloud edge aerosol retrievals

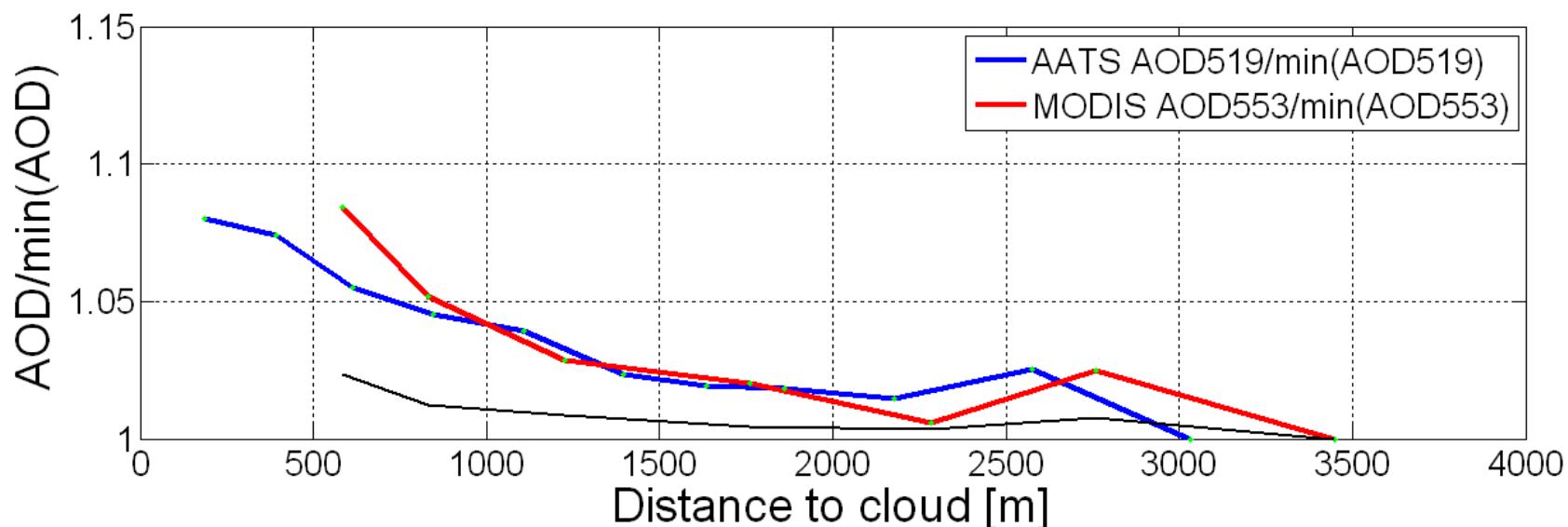
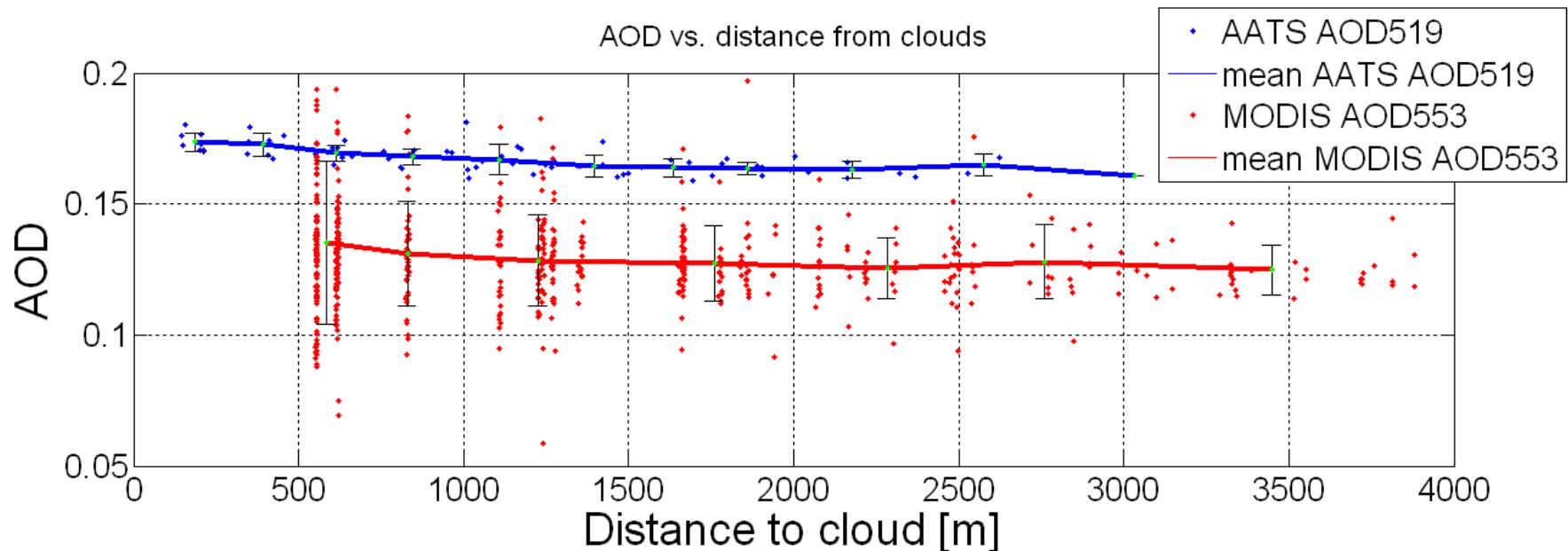
AOD (553nm),MODIS,Aqua,121,4/30/2004,UT:21:30–21:35,thresh=0.0025



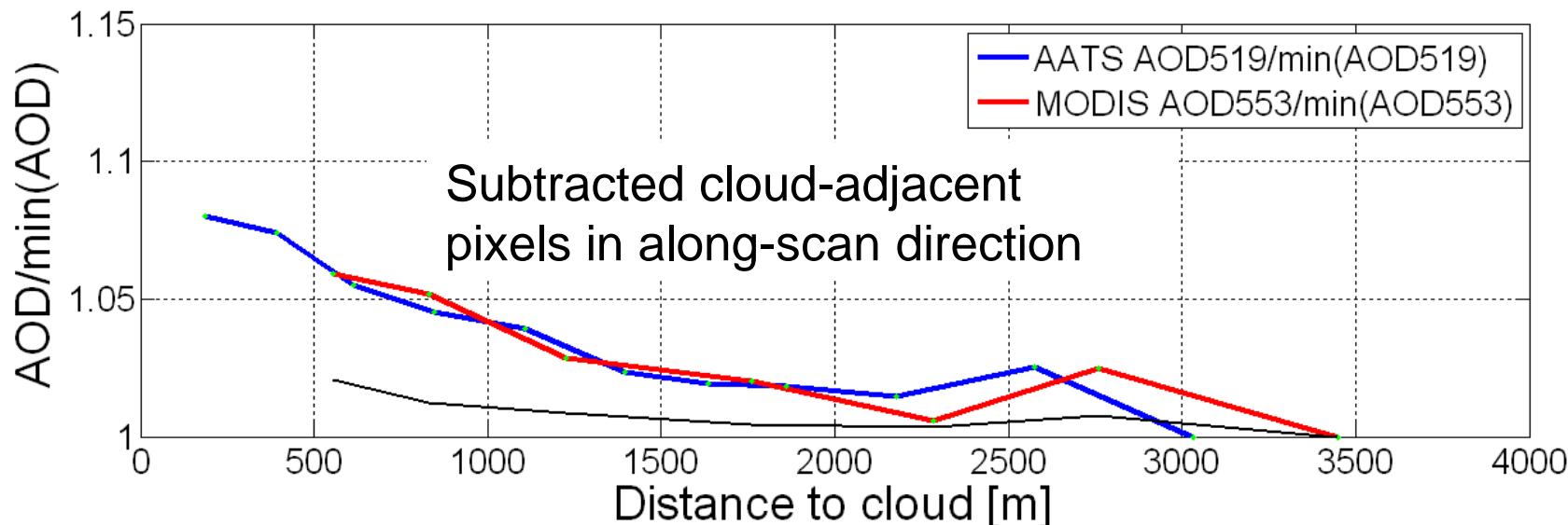
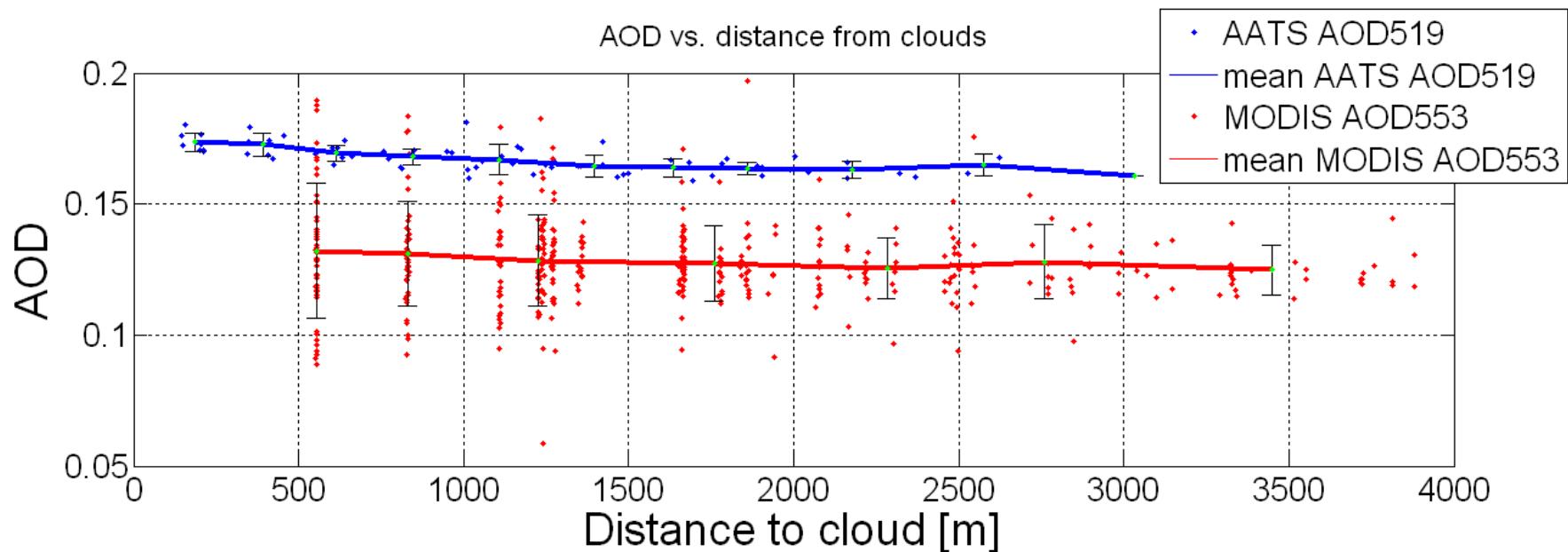
Angstrom,MODIS,Aqua,121,4/30/2004,UT: 21:30–21:35



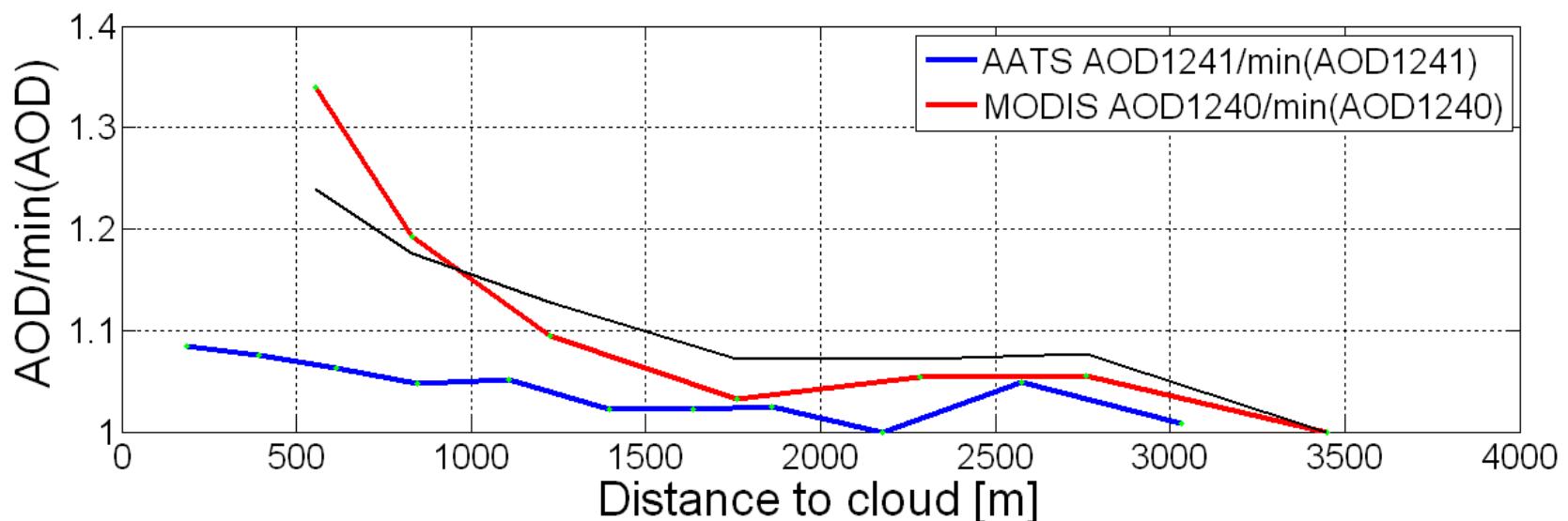
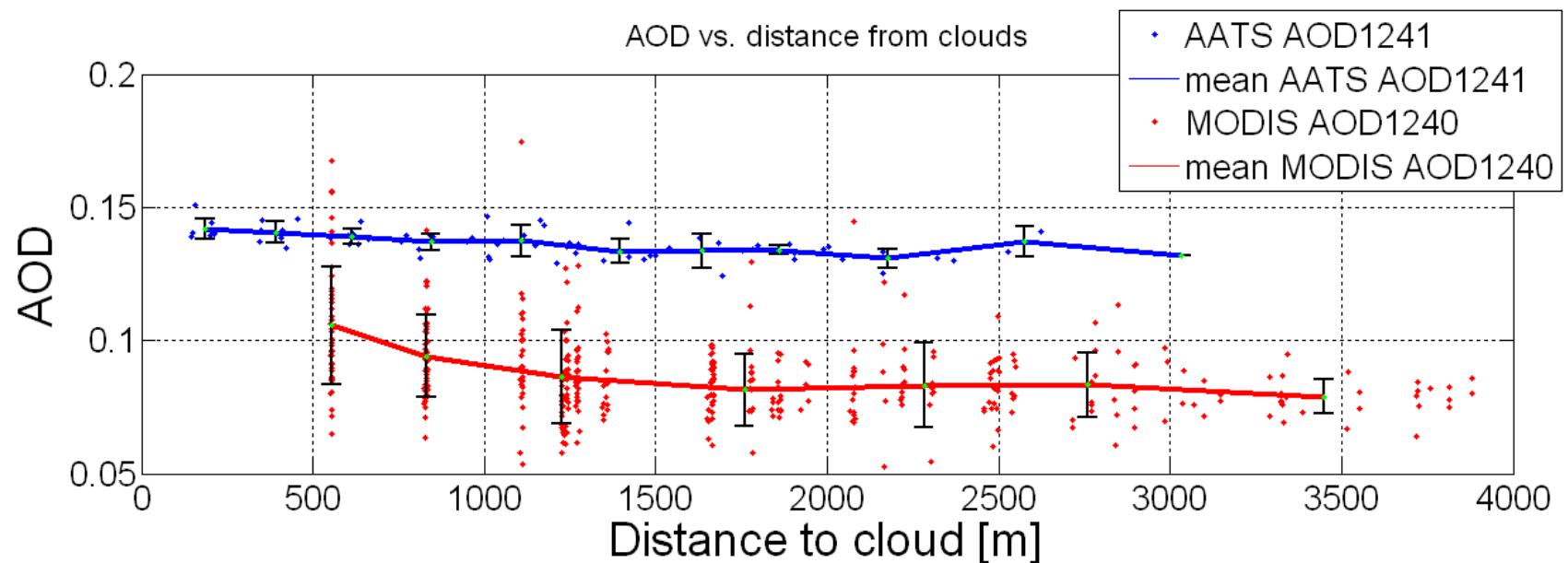
# MODIS (500m) 553nm-AOD versus airborne sunphotometer



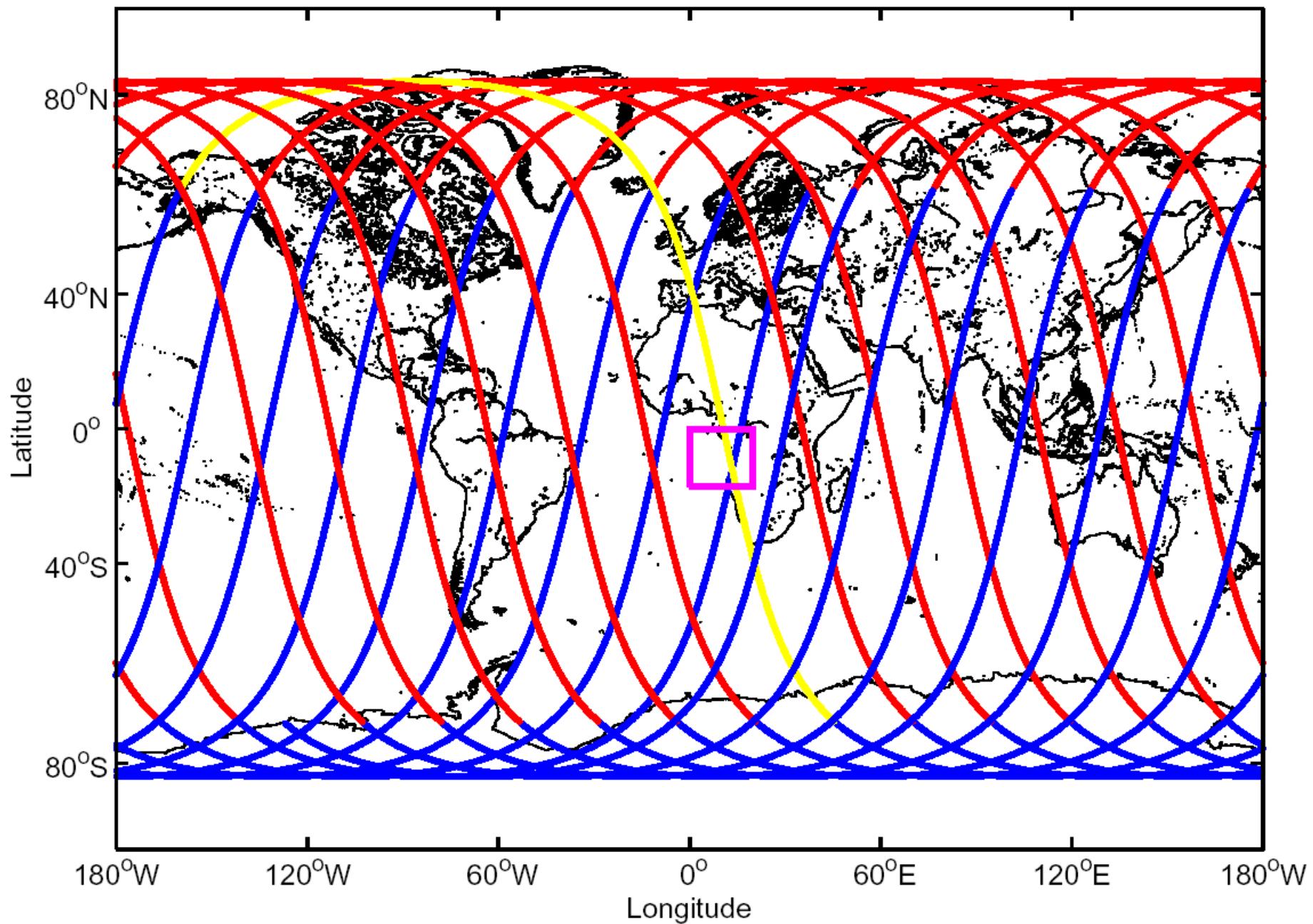
# MODIS (500m) 553nm-AOD versus airborne sunphotometer



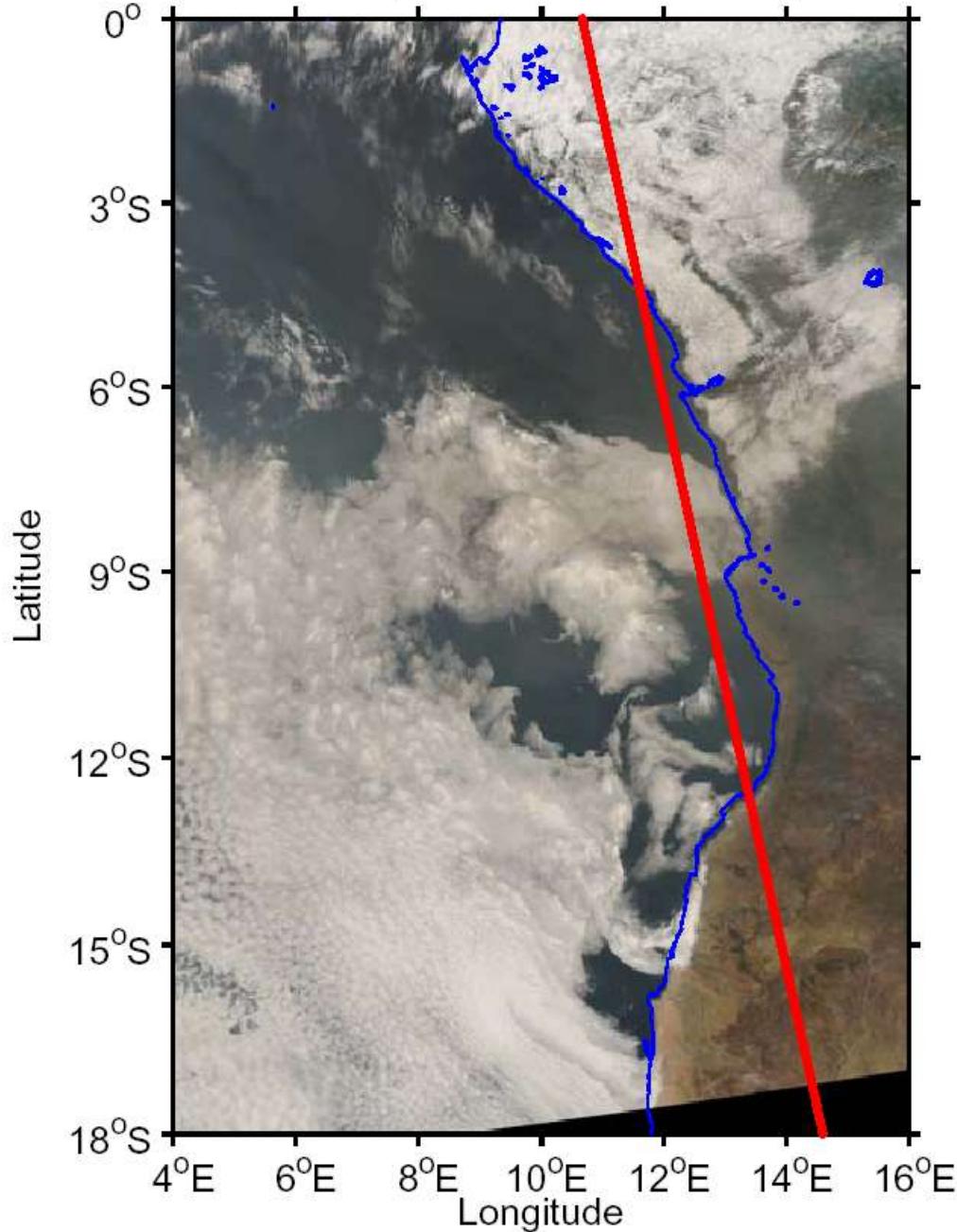
# MODIS (500m) 1240nm-AOD versus airborne sunphotometer



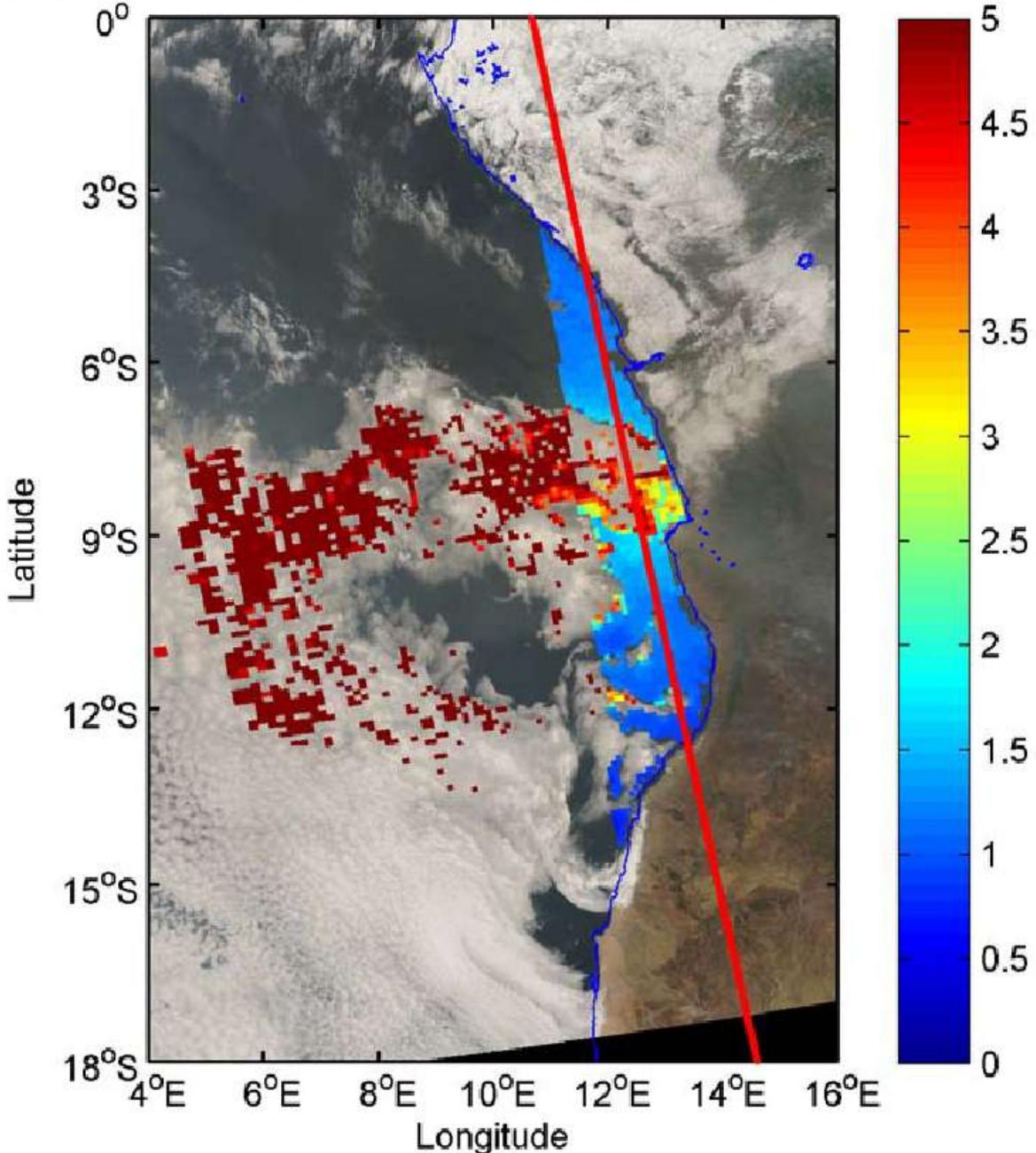
CALIPSO, 2006-08-12, 12:40-13:32 (yellow)



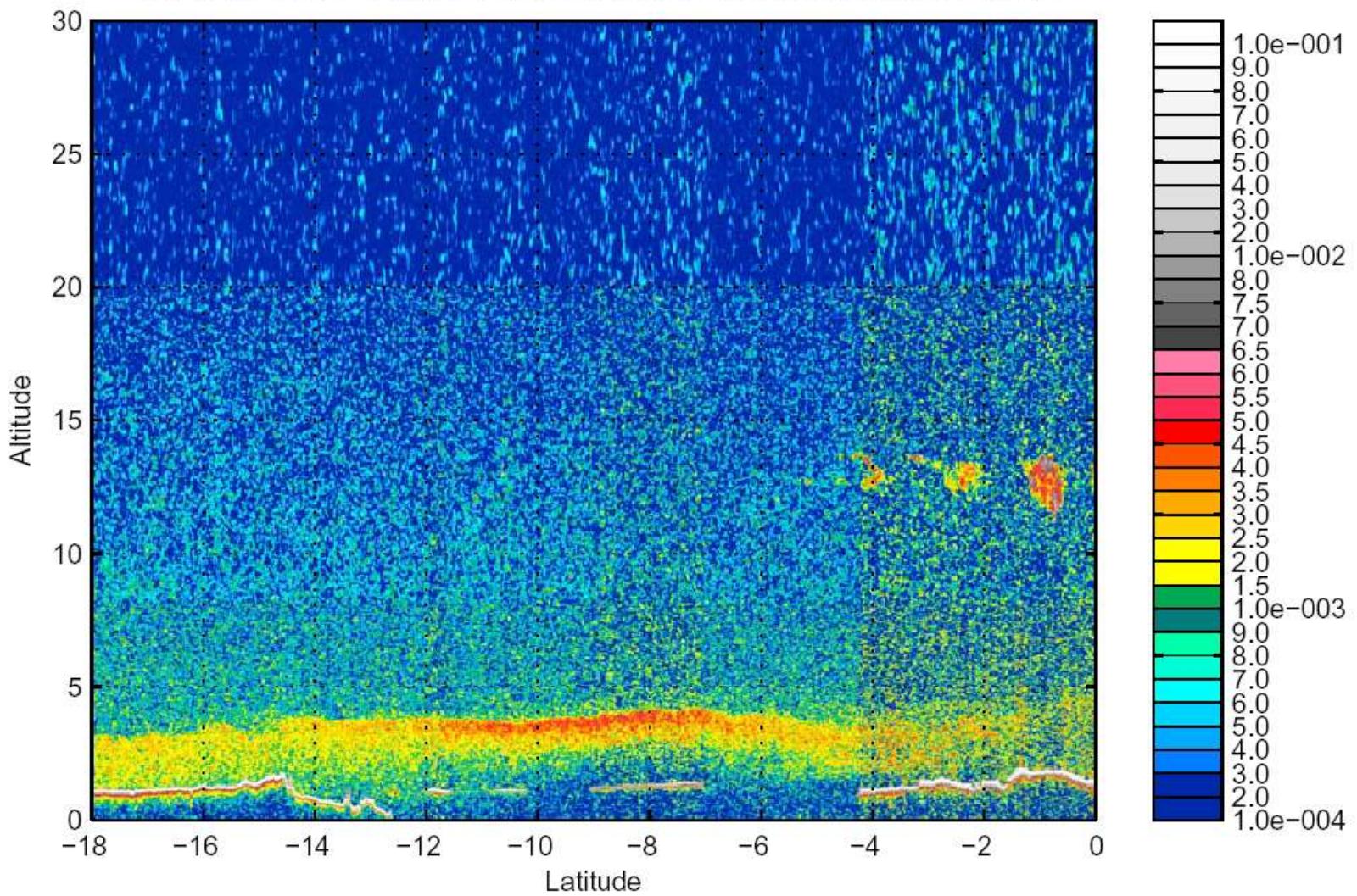
# RGB Aqua 12:55,CALIPSO 12:40,2006-08-12



# Aqua AOD550,CALIPSO track, 12:55,2006-08-12

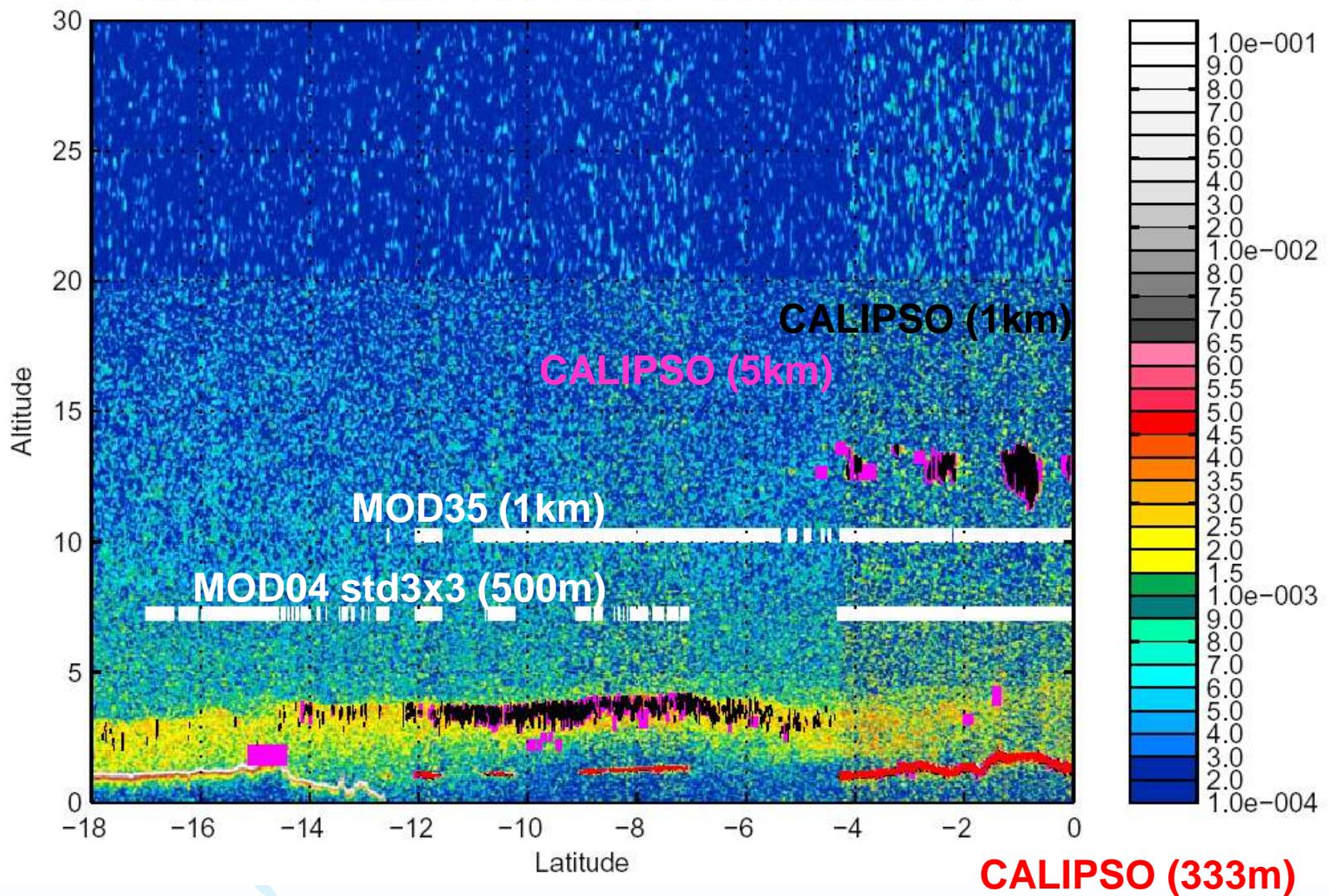


# CALIPSO Total Attenuated Backscatter 532



# Comparison of cloud detection: MODIS vs. CALIOP

## CALIPSO Total Attenuated Backscatter 532

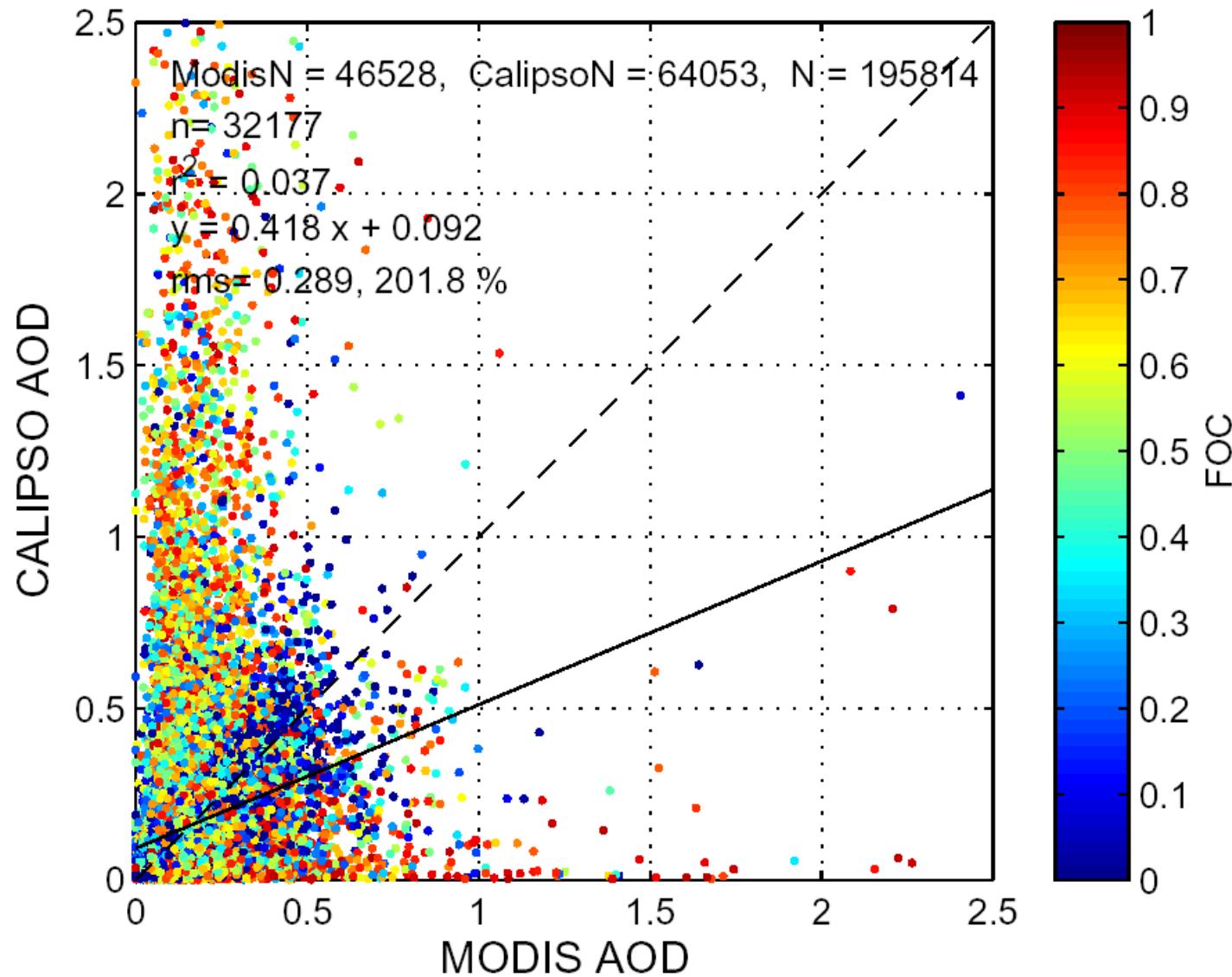


# Aerosol Optical Depth comparisons

- ↗ One month of data, April 2007
- ↗ Use CALIPSO 40km-avg. aerosol extinction profiles, and 5km aerosol and cloud layer products
- ↗ Find all (up to 4) **instantaneously collocated**, MYD04\_L2 10x10km aerosol retrievals traversed by CALIPSO track
- ↗ Focus on over-ocean only
- ↗ Apply three CALIPSO profile quality criteria:
  1. Alt\_top\_aerosol > Alt\_top\_cloud
  2. EQC532\_flag = 0 or 1
  3. Integrated attenuated backscatter @ 532 <=0.011
- ↗ Stratify by MODIS cloud fraction
- ↗ Break down geographically

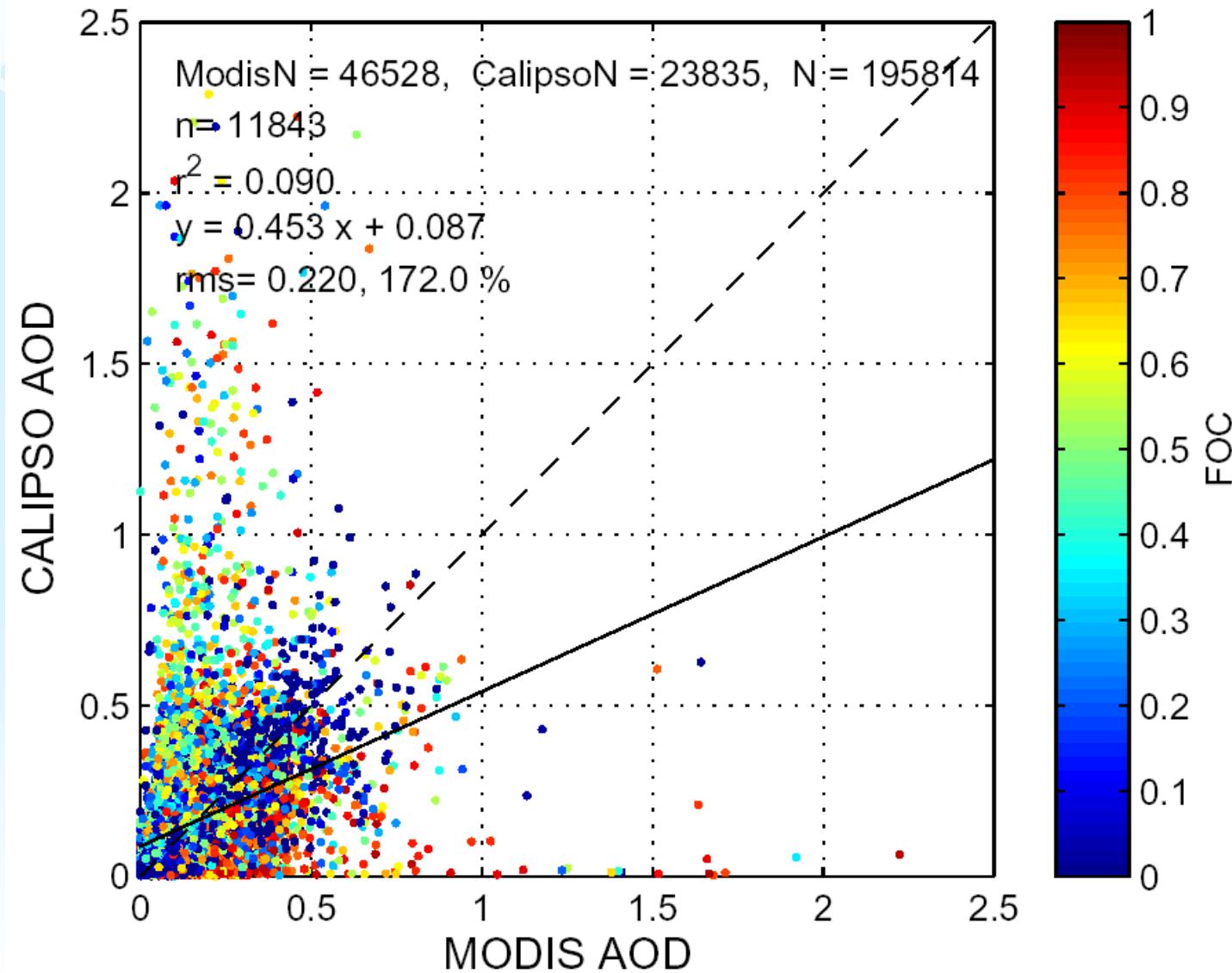


# AOD scatter plot, 2007–04, Ocean only



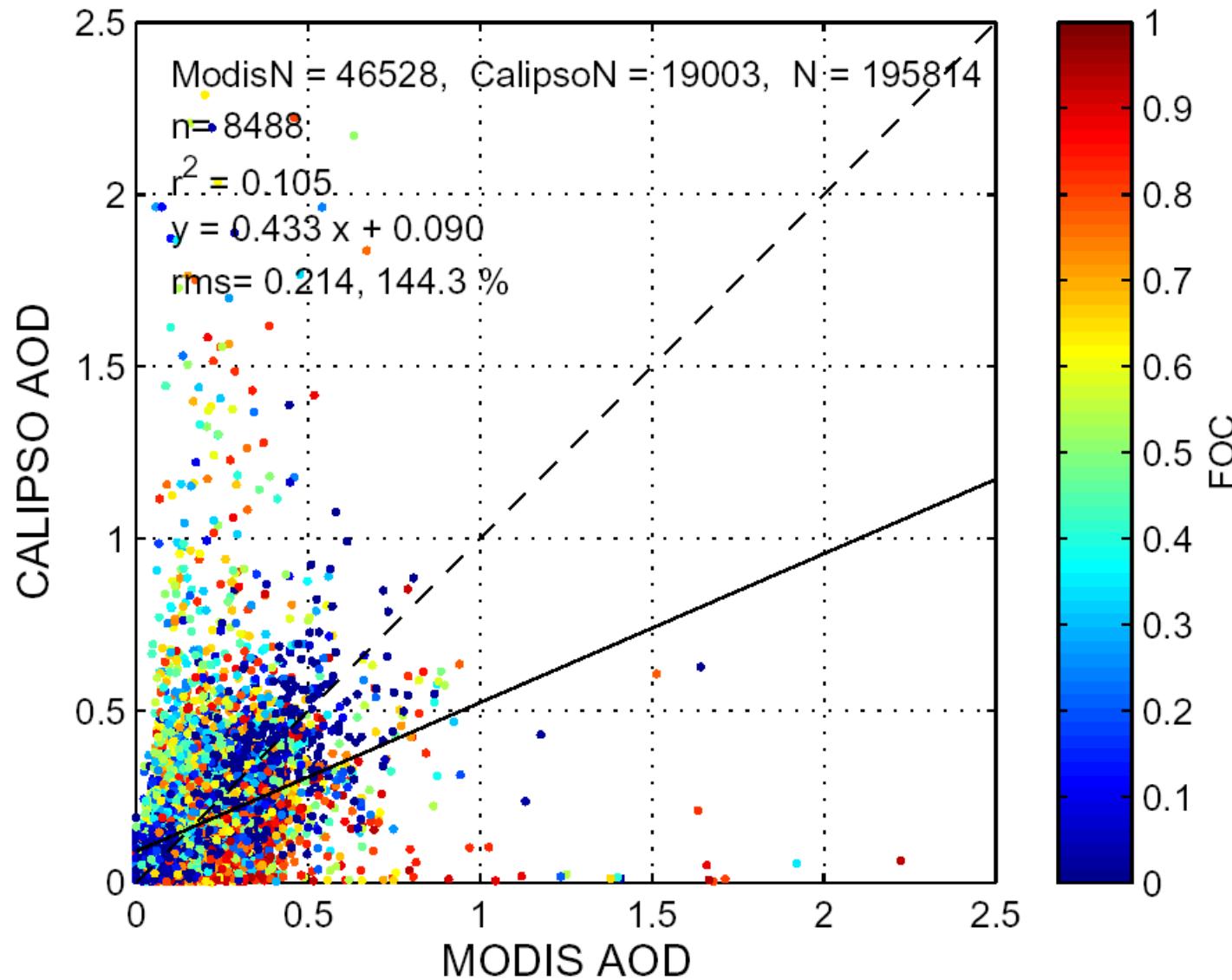
Alt\_top\_aerosol > Alt\_top\_cloud

AOD scatter plot, 2007-04, Ocean only, uppermost

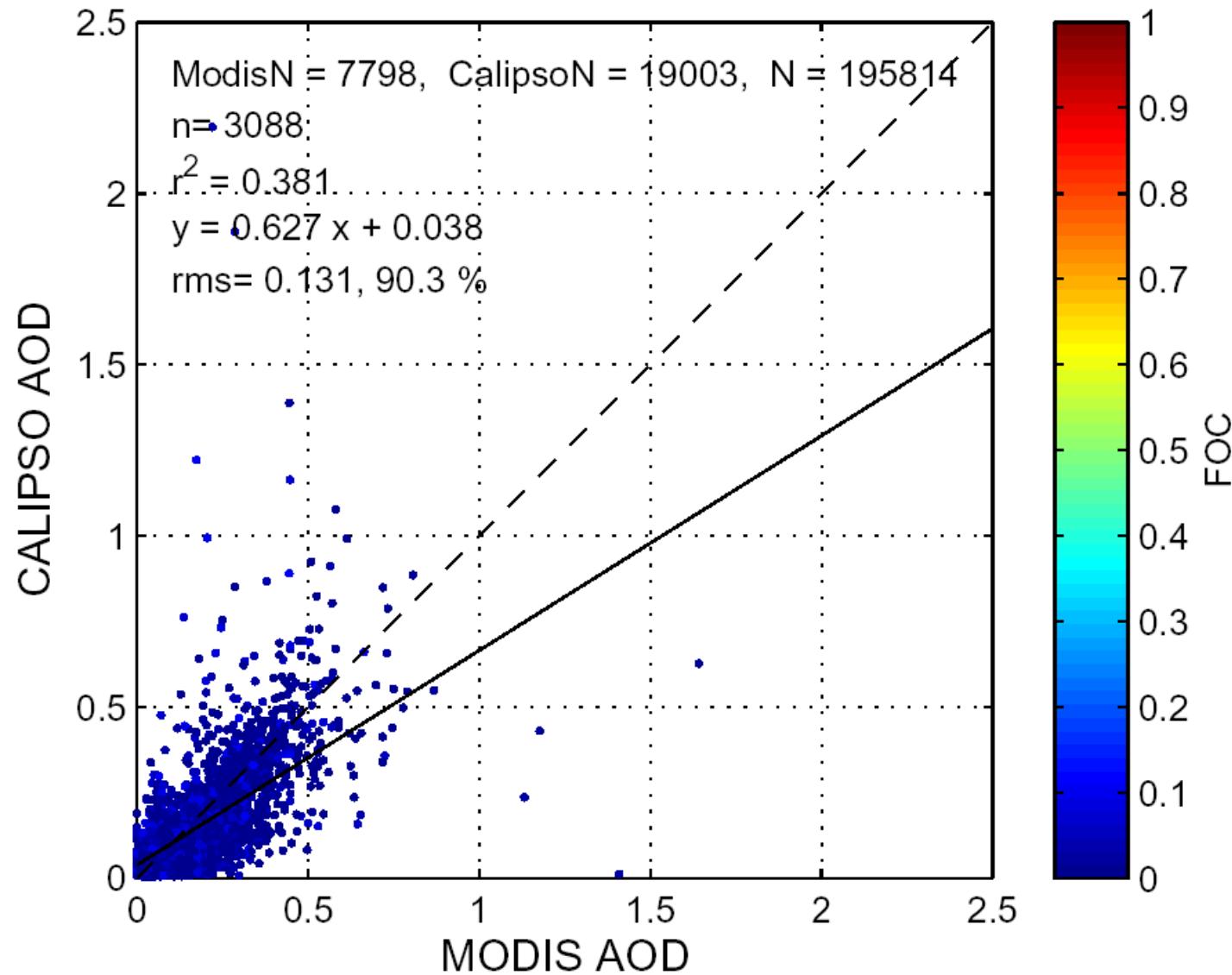


# All three quality controls

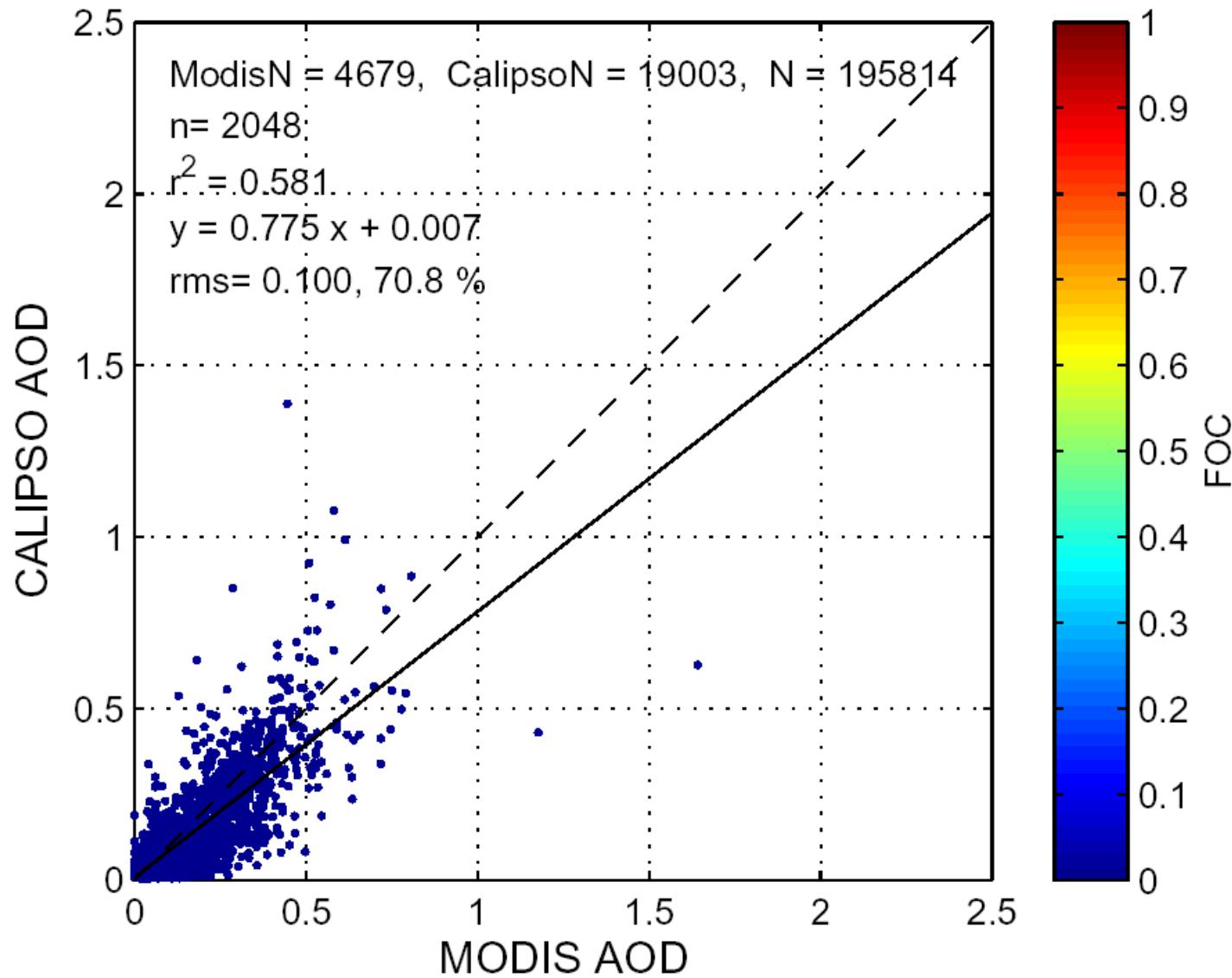
## AOD scatter plot, 2007–04, Ocean only, 3–QC



# AOD scatter plot, 2007–04, Ocean only, 3-QC, FOC < 0.1

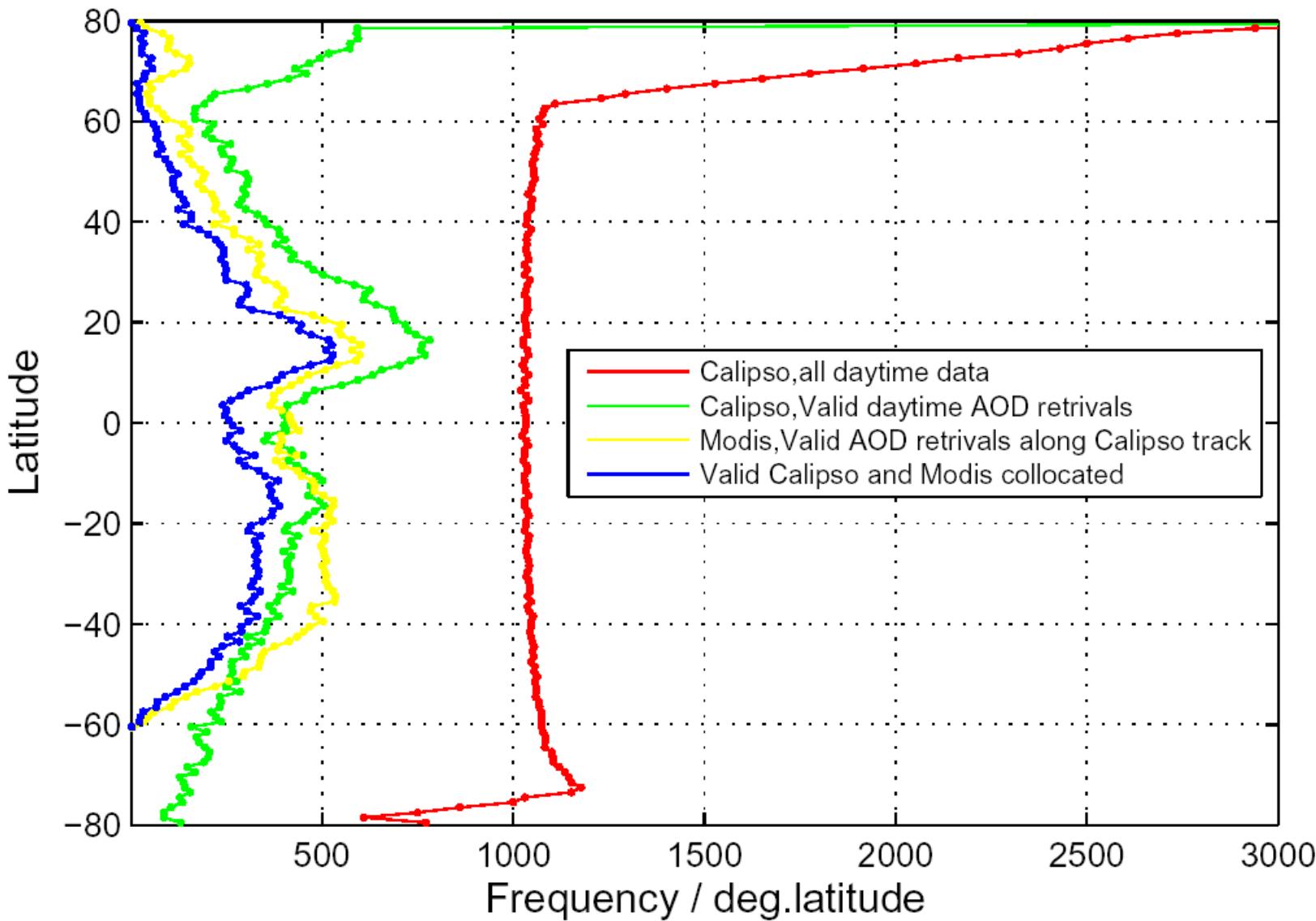


# AOD scatter plot, 2007–04, Ocean only, 3-QC, FOC < 0.01



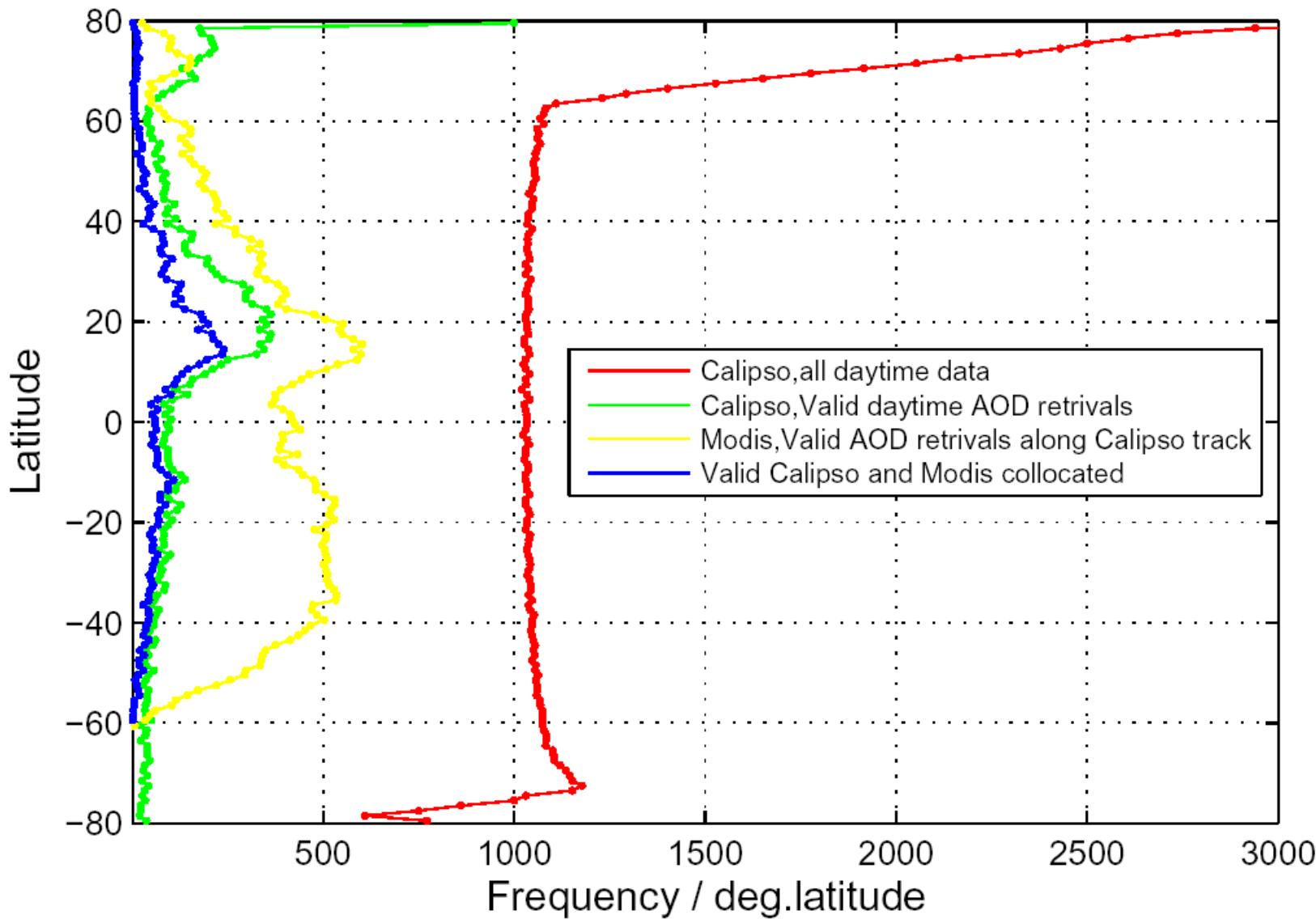
# Zonal dist. of CALIPSO and MODIS aerosol retrievals

Frequency vs. Lat., 2007-04, Ocean Only, no QC

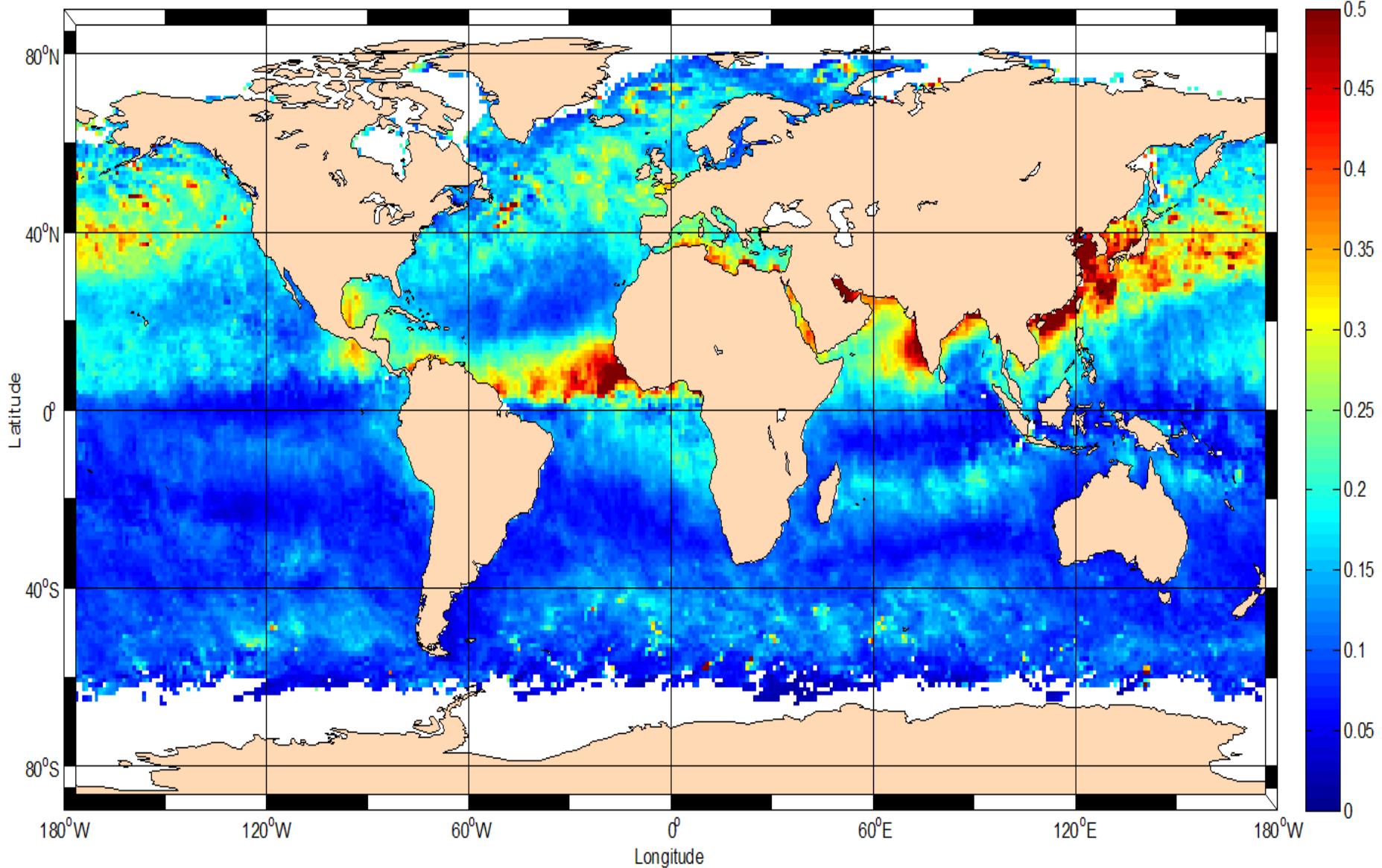


# Zonal dist. of QC CALIPSO and MODIS aerosol retrievals

## Frequency vs. Lat., 2007–04, Ocean Only, 3–QC

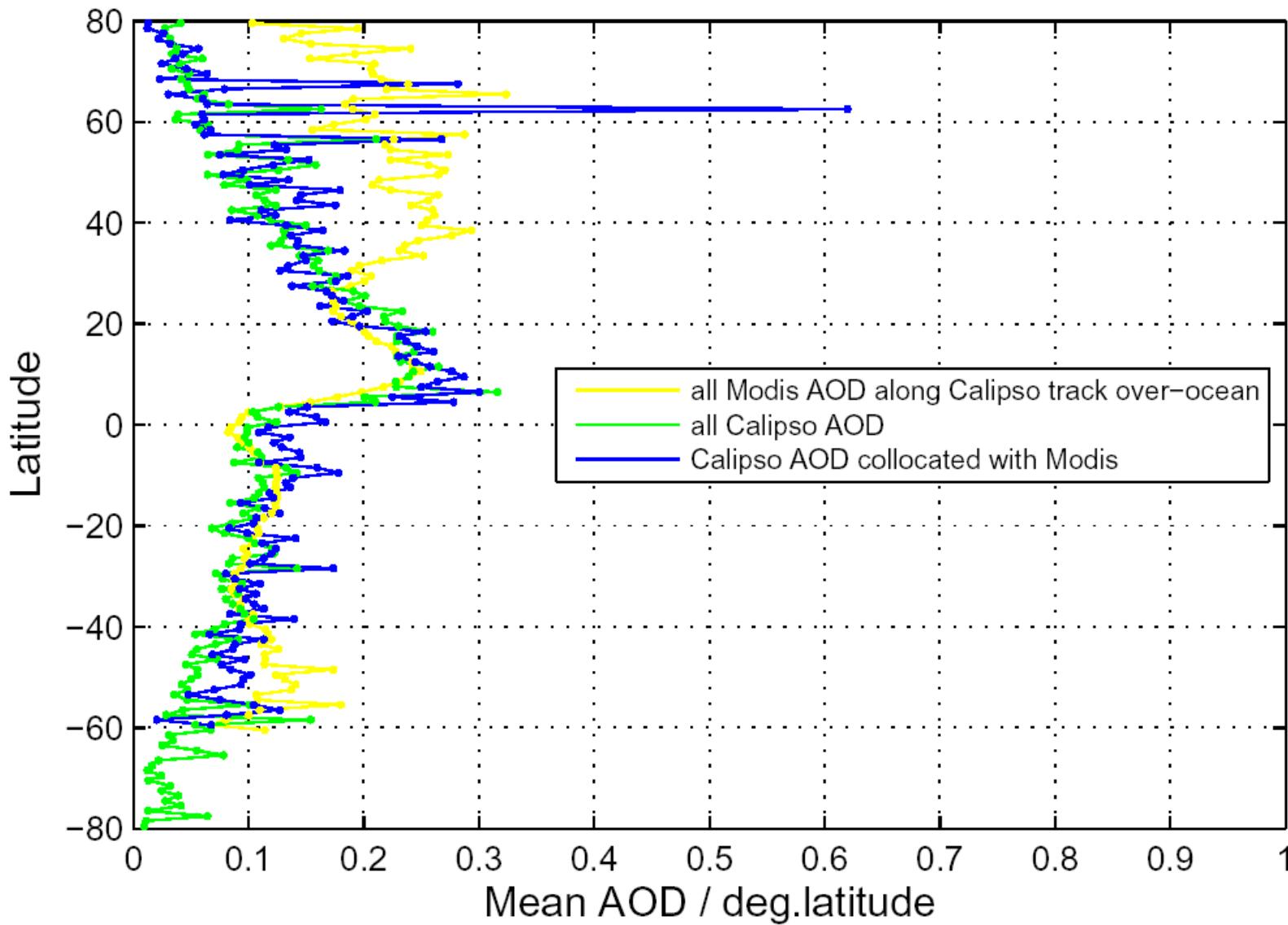


Modis AOD monthly average (MYD08-M3),2007-04,Ocean Only

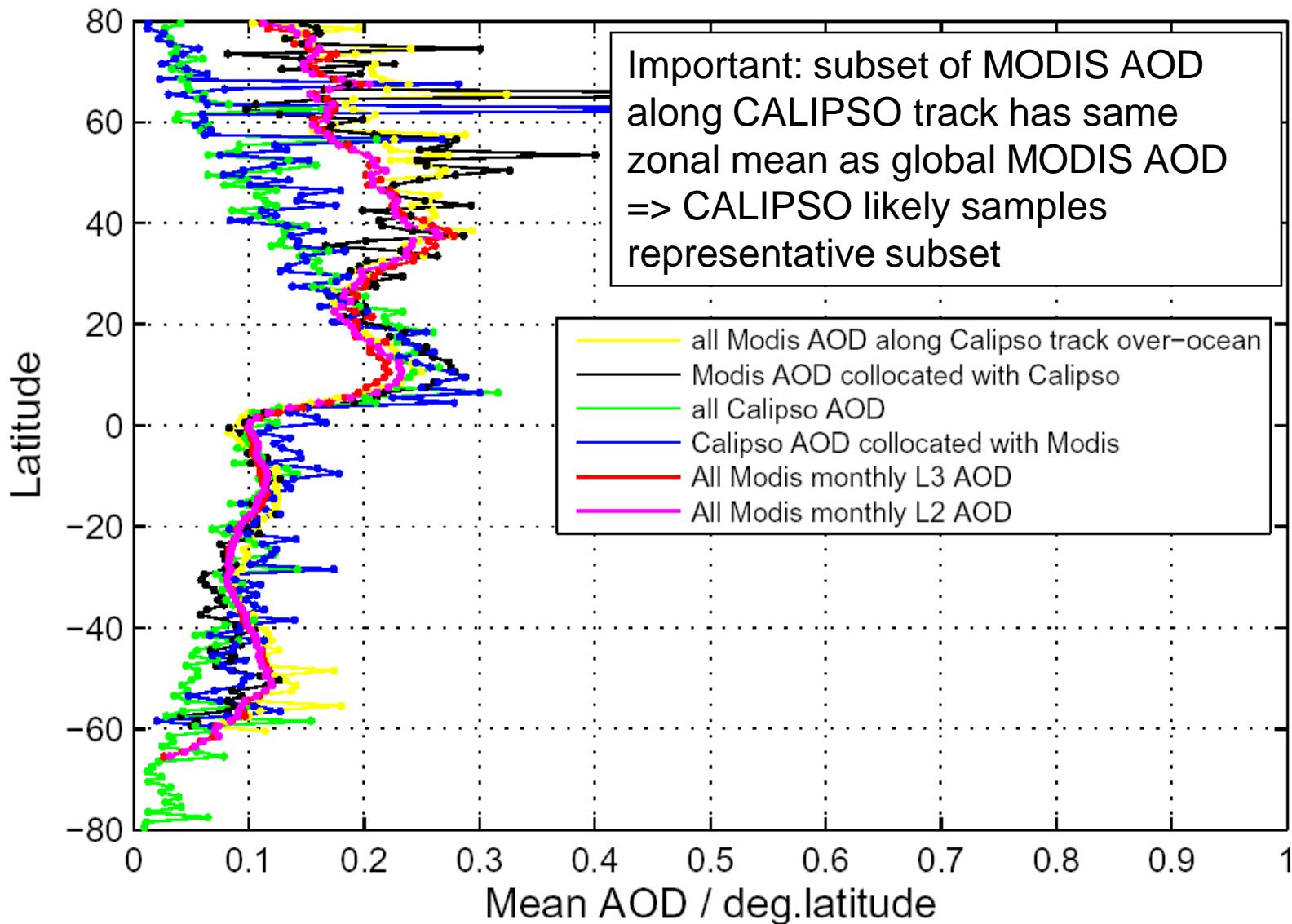


# Zonal dist. of CALIPSO and MODIS AOD

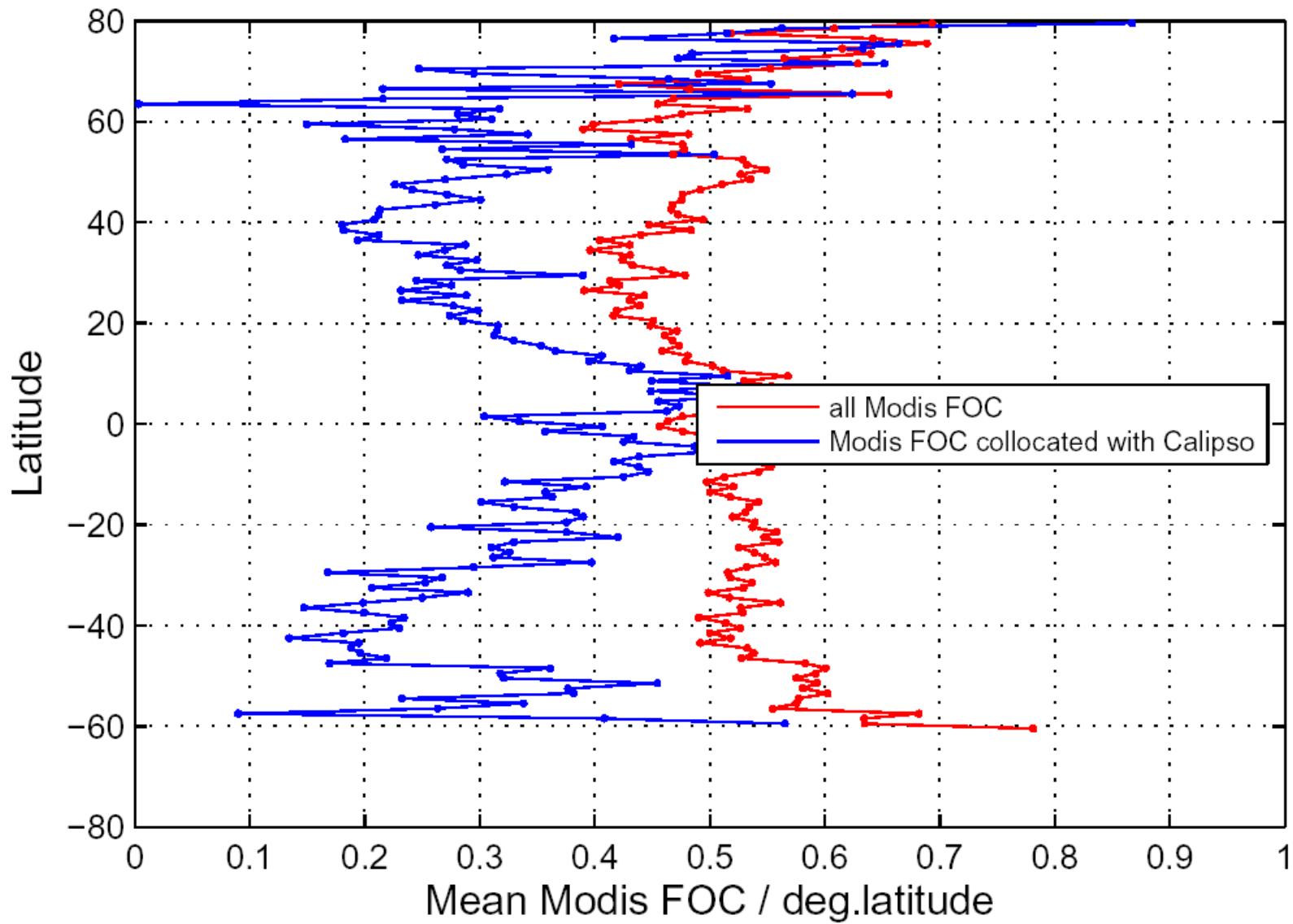
AOD vs. Lat., 2007–04



## AOD vs. Lat., 2007–04

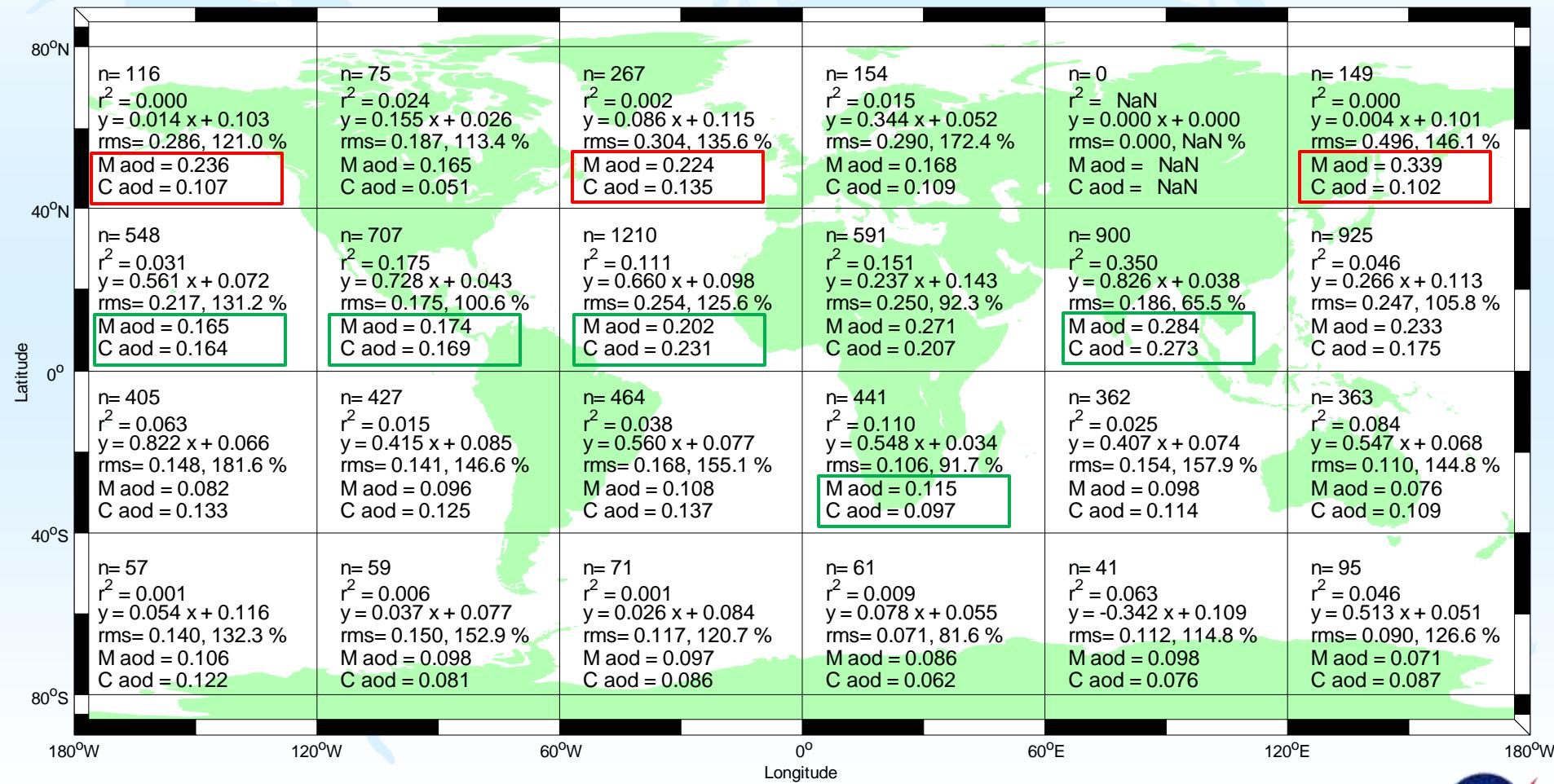


# Modis FOC vs. Lat., 2007-04

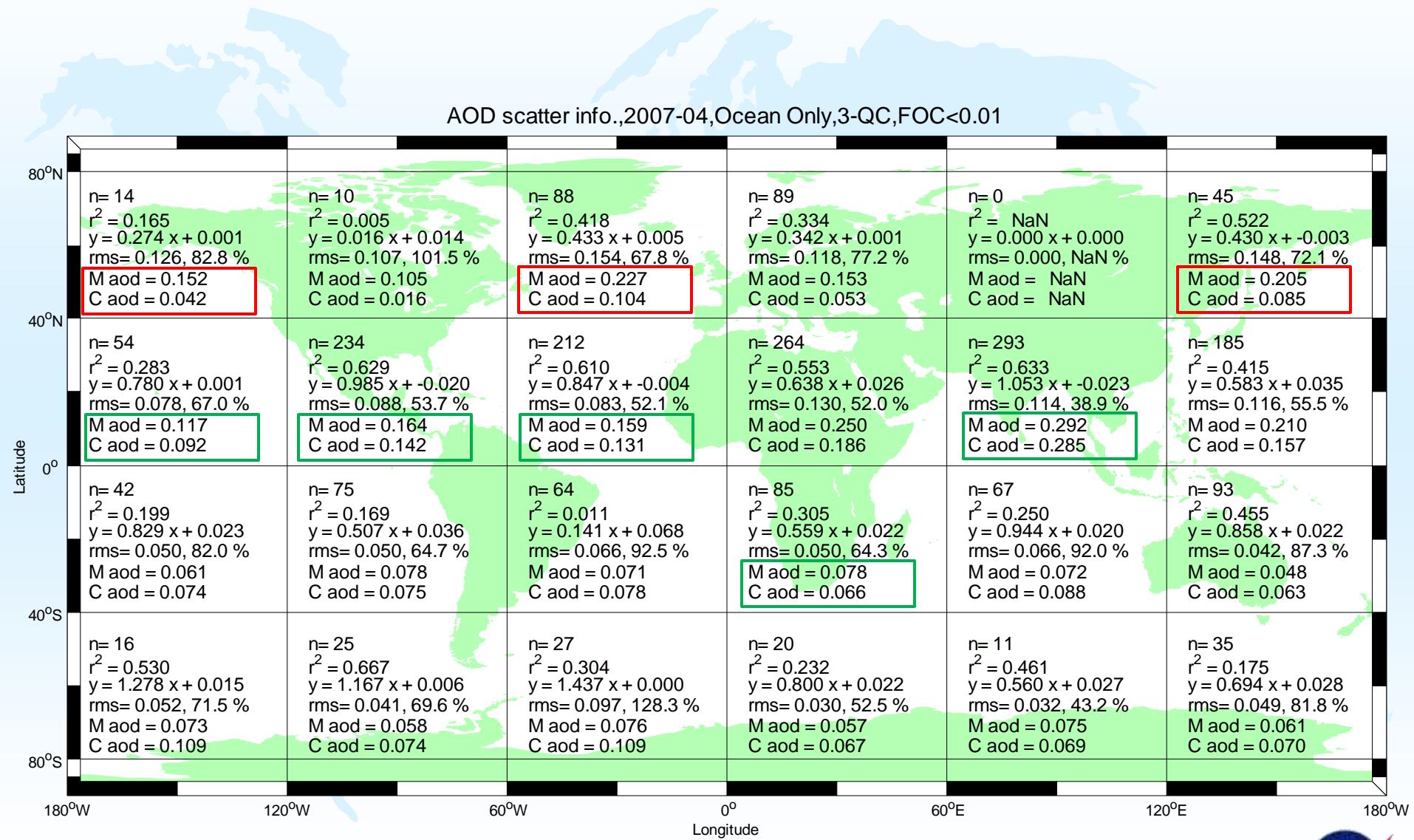


# Geographical distribution of correlation data, all cloud fractions

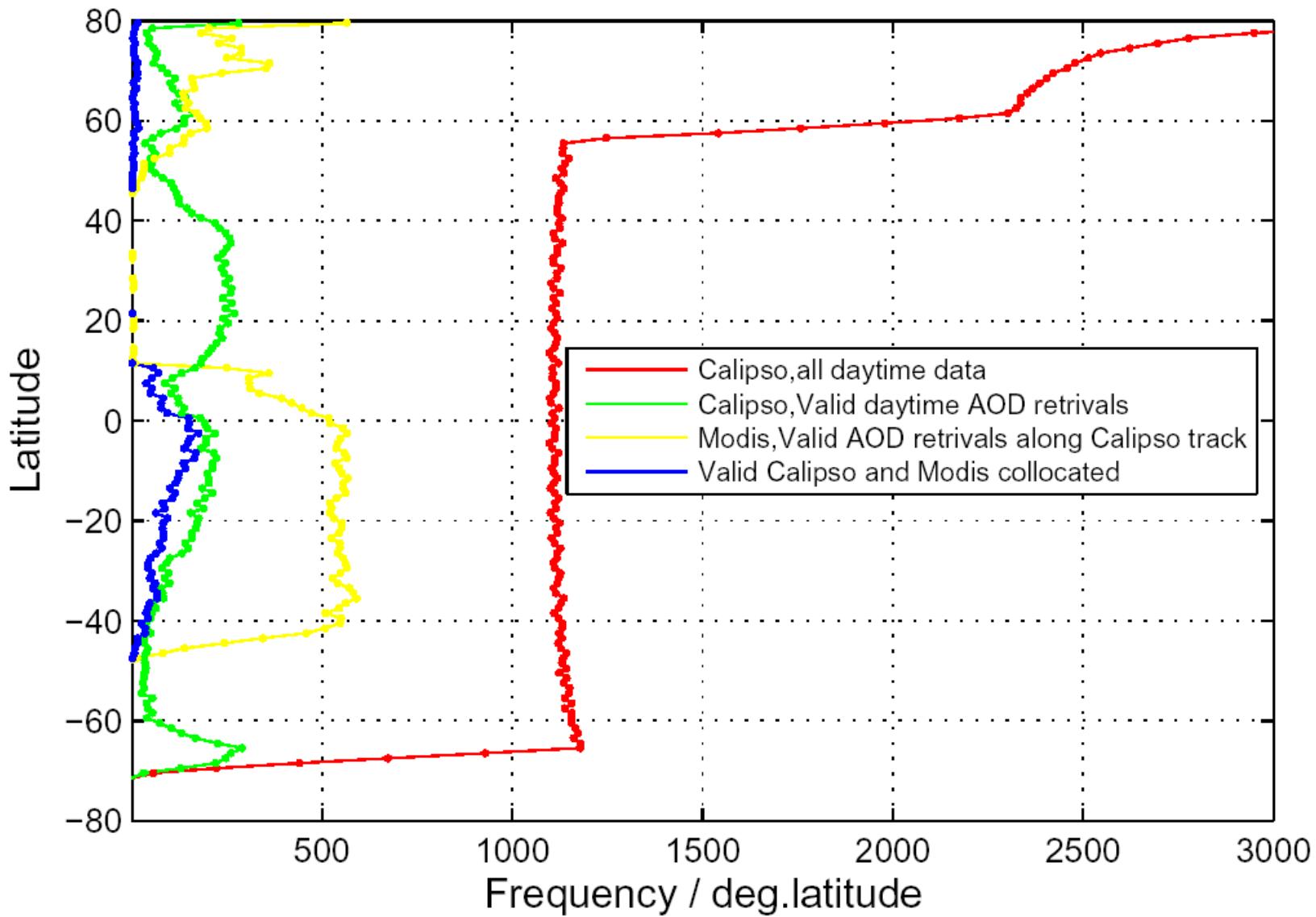
AOD scatter info.,2007-04,Ocean Only,3-QC



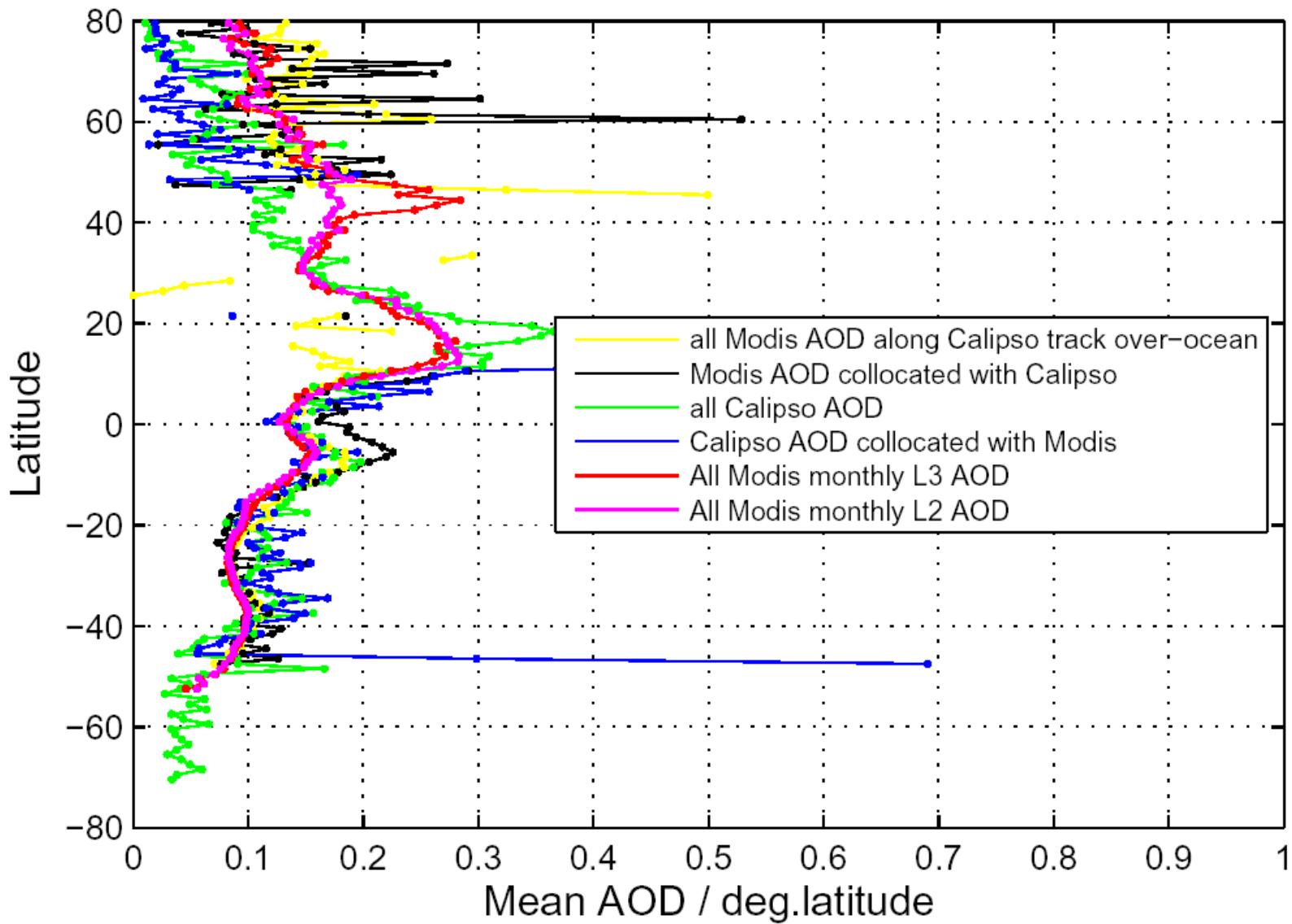
# Geographical distribution of correlation data, cloud fractions < 1%



# Frequency vs. Lat., 2007-07, Ocean Only, 3-QC



# AOD vs. Lat., 2007–07



# Conclusions

- 1) Different cloud screening techniques in MODIS and CALIPSO aerosol algorithms produce very different results, making search for collocated data complicated.
- 2) April 2007 AOD comparisons:
  - Total CALIPSO: ~ 195,000
  - Valid CALIPSO AOD: ~ 64,000
  - Valid CALIPSO and collocated MODIS AOD: ~32,000
  - Valid QC'ed CALIPSO and collocated MODIS AOD: ~8,500
  - Valid QC'ed CALIPSO and collocated MODIS AOD, FOC<1%: ~2,000
- 3) Most data between 0-20N
- 4) For “clear” conditions (FOC<1%), correlation is starting to look decent, with CALIPSO AOD lower than MYD04\_L2 by about 20%
- 5) Largest disagreement between MODIS and CALIPSO at 30-80N
- 6) MODIS data collocated with CALIPSO has same zonal mean AOD as entire MODIS data set => CALIPSO likely samples representative subset